# Seed structure and germination in *Borassus aethiopum* Mart.

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***Borassus aethiopum*** **Mart. (Arecaceae, Coryphoideae) is a dioecious tree (Fig. 1) endemic to Africa which is widely distributed in savannah regions of the continent (Fig. 2). It is a multipurpose palm playing a prominent socio-economic role in local population (Fig. 3). In Benin, the hypocotyls are exploited for human diet resulting in an intense pressure on natural stands of the species with consequences on regeneration. The lack of information on seed germination and conservation hinders seedling production for sustainable *Borassus aethiopum* population management. In this context, we have undertaken to first describe the morpho/anatomy and germination behaviour of mature seeds, for the purpose of later addressing the physiological aspects of seed conservation.**


**Figure 2**: Distribution of *Borassus aethiopum* Mart. in Africa


**Figure 3**: Some products obtained from *B. aethiopum*. a: fruit, b: stipe used for house construction, c: fruit sowing for hypocotyl production d: hypocotyl harvest

**Figure 1**: *Borassus aethiopum* Mart.

## GERMINATION

The fruit of *B. aethiopum* is a spherical drupe of about 14,5 cm in diameter with a mean weight of 1.2 Kg. It contains one to three seeds (Fig. 4). At maturity, the fruit falls to the ground, where the pulp decays releasing the kernels which germinate between 2 and 4 weeks later by remote germination (Fig. 5). The water content of isolated fresh seeds with endocarp was found to be high (47%) (Tab. 1).

**Table 1**: Some parameters related to seed germination of *B. aethiopum*

| Parameters | Values |
|---|---|
| Water content before sowing (%) | 47 ± 0.4 |
| Rate of germination | 70% |
| Average days of germination | 28 ± 5 |


**Figure 4**: Cross section of fruit


**Figure 5**: Time course of germination.
D: number of days after sowing (1st day of germination) ; DAG: number of days after germination

**Figure 6**: Seed of *B. aethiopum*

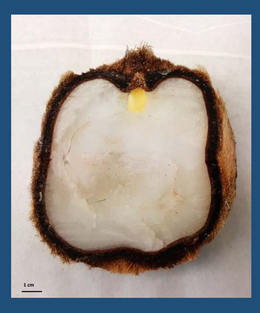

**Figure 7**: Cross section of seed

## SEED ANATOMY

Seeds of *Borassus aethiopum* are of the albuminous type surrounded by a very hard endocarp (Fig. 6-7). They are flattened globose in shape measuring 82 x 52mm and weighing 183 g on average .

### Integument

The seed tegument is more or less adherent to the endocarp and consists of dead cells and contains abundant phenolic compounds (Fig. 8B and Fig. 9).

### Endosperm

In mature seed the endosperm is very hard with a soft heart (Fig. 7 and Fig. 8A).
The endosperm cell walls are very thick and rich in sugar (staining in pink) (Fig. 8D1). The cells are interconnected by plasmodesma fields (Fig. 8D2) and contain abundant protein reserves in a form of protein bodies (staining in blue) (Figs. 8 C1) as well as lipid bodies (Figs. 8 E1 and E2).
In the distal region of the embryo, endosperm cell degradation pattern can be distinguished, demonstrating initiation of endosperm reserve mobilization toward the embryo (Figs 8 F1 and F2).

### Embryo

The embryo is egg-shaped, located at the periphery of the endosperm and is approximately 1 cm in length (Fig.7 and Fig. 8A). RX tomography suggests the presence of an operculumn (seed seal) in the micropylar region with an interruption of woody endocarp (Fig. 9). The embryo consists of a massive cotyledon and embryo axis.

- The haustorium (distal part of the cotyledon) exhibits large cells with one central vacuole (Fig. 8H) and highest density of starch grains (Fig. 8G) at the distal region by contrast with proximal region. The haustorium contains many vascular bundles positioned perpendicular to its surface (arrow) (Figs. 8 I1 and I2)
- The plumule is well differentiated with leaf primordia surrounded by two leaf scales (Figs. 8 L1 and L2).
- The root pole appears at the embryo base as a meristematic zone (Zone "M", feature of palm embryos) (Fig. 8J).
- The **Protoderm** is clearly distinguished by a single layer of rectangular polarized cells containing one large distal vacuole and a small nucleus at their basis (Fig. 8K).

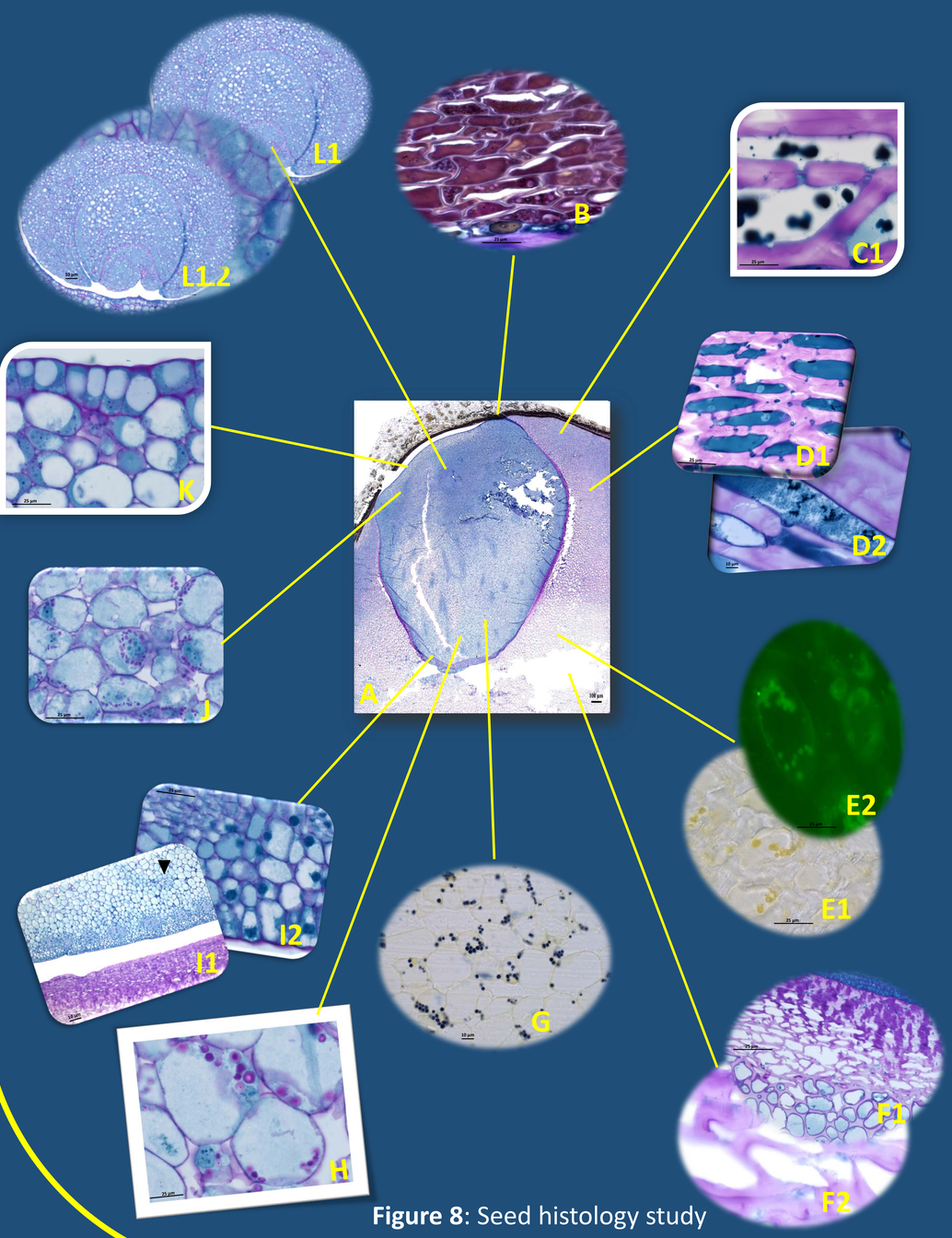


**Figure 8**: Seed histology study

***Staining***: *periodicacid-Schiff (PAS) and naphtholblue–black (NBB): A, B, C, D, F, H, I, L, J, K ; Nile Red: E2 ; Lugol: E1, G.*

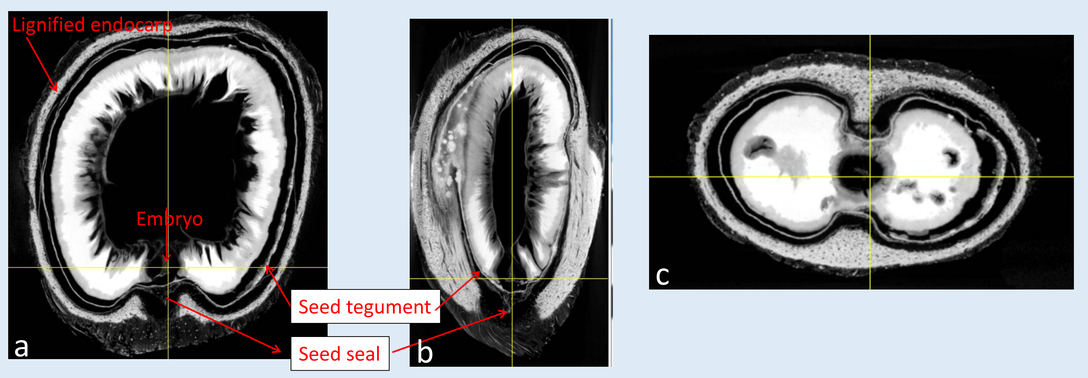


**Figure 9**: High-resolution X-ray computed tomography image of *B. aethiopum* seed.
a: sagittal view, b: lateral view, c: transverse view at the level of embryo locule.

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